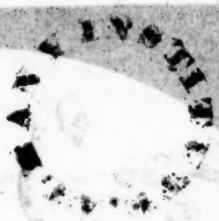


THE NATURALIST.

AUGUST, 1832.

THE MICROSCOPE.

NO. II.

ACTIVE MOLECULES

In Organic and Inorganic Bodies, discovered by Robert Brown, Esq. F. R. S. &c. &c. &c.

This indefatigable gentleman, in prosecuting his elaborate researches into the vegetable kingdom, was led to infer (from circumstances connected with the investigation of the pollen of plants suspended in water,) that the same active molecules might likewise exist in inorganic bodies; he has not been disappointed, having succeeded in separating them from almost every known substance, such as minerals, glass, common dust, soot, &c. &c.; indeed, the principal exceptions are oil, resin, wax, sulphur, such of the metals as could not be reduced to that minute state of division necessary for their separation, and finally bodies soluble in water.

The process of obtaining a satisfactory view of these minute active molecules is exceedingly simple, and is as follows: with the head of a pin place a small drop of distilled or filtered water upon a slip of glass, then apply the head of the pin (again dipped in the water) to the substance from which the molecules are to be separated, which is effected by a slight friction: afterwards immerse the head of the pin in the water upon the slip of glass,

gently agitating it; this will occasion the molecules to be transferred to the water upon the glass, which is then in a state to be submitted to the deep powers of the microscope: to separate the molecules from the glass itself, either pound it very fine, or gently rub together the unpolished edges of two pieces, having previously wetted them—the produce can then be transferred to a drop of water.

The figure of the molecules is spherical: they are so minute that four hundred millions of them would not occupy greater space than a superficial square inch. Their motion is very vivid, and consists, not only of a change of place in the fluid, manifested by alterations in their relative positions, but also, not unfrequently, of a change of form in the particle itself; each molecule appears to revolve upon its axis: in fact, the whole of the motions are very similar to those of the most minute kind of animalcules inhabiting water.

Some persons have considered the motion to result from the evaporation of the fluid and the action of the breath of the observer upon its surface: this is proved not to be the case, by covering the water with a thin piece of talc, when the motions continue unaltered; it has likewise been urged that these spherical molecules may be hollow, and that the motion is produced by the water entering them, thereby displacing the air contained in them—were this the case, the action must soon subside, which does not take place: besides, the molecules are proved to be suspended *within* the fluid, by bringing the surface to the true focus, when a variety of *irregular* particles (distinct from the molecules) will be discovered evidently acted upon by exterior causes.

When it is considered that there is not the slightest difference in the general figure of these active molecules (let the substance be what it may, from which they are separated,) it will be conceded that their identity gives them a character which makes it difficult to prove their figure and motions to be the result of mere chance, exterior mechanical causes, or optical delusion; this has been kindly shown by Mr. Brown to the editor, who is perfectly of that gentleman's opinion.

INFUSARIA, OR ANIMALCULES IN VEGETABLE INFUSIONS. The smallest living creatures we are acquainted with, are the animalcules in fluids; they afford a wonderful scope for inquiry, and inothing is more capable of affording instruction combined with amusement, than researches into the secrets of Nature in the more minute parts of her works; and it presents to view the most surprising wonders hitherto unknown; for who would or could have magined that, in a single drop of water, thousands of living crea-

tures are found, most of them invisible to the naked eye, and so extremely minute, that many thousands of them will not cover the space of a grain of sand; the littleness into which Nature descends in these productions, nevertheless, offers one of the most agreeable subjects for instruction and admiration; for by comparing one of these minute living creatures with a larger animal, whose appearance is terrific, what a disproportion is observable, and what efforts of the imagination does it not require to conceive the smallness of the parts of this minute living creature, for it will appear they are furnished with as many or more members than the largest animal: they must have the means for the circulation of the blood, a stomach for receiving their food and digesting it;—in a word this little world contains objects, of the number and variety of which we cannot have the smallest idea without the assistance of the microscope.

CLASS OR DIVISION OF THE ANIMALCULA INFUSARIA.

Those that have no External Organs. 1. Monas punctiforme; a mere point. 2. Proteus mutabile; mutable or changeable. 3. Volvox; spherical. 4. Enchelis cylindraceum; cylindrical 5. Vibrio elongatum; long.

Membranaceous. 6. Cyclidium; oval. 7. Paramæcium; oblong. 8. Kolpoda; crooked. 9. Gonium; with angles. 10. Bursaria; hollow like a purse.

Those that have External Organs. 11. Cercaria; with a tail. 12. Trichoda; hairy. 13. Kerona; horned. 14. Vorticella; the apex ciliated.

EQUIVOCAL OR SPONTANEOUS GENERATION. Equivocal or spontaneous generation, that is, the production of plants without seeds, and of living creatures without any other parents but accident and putrefaction; such was the absurd opinion that prevailed of the production of the minute living creatures, before the microscope overturned it, by demonstrating that all plants have their seeds, and all animals their eggs, whence the same species are produced. Nothing seems more contrary to reason than to suppose that chance should give being to regularity and beauty, or that it should create living animals, fabricate a brain, nerves, and all the parts of life; and, as Mr. Baker observes, we may as well suppose that the woods generate stags and other animals that inhabit them, as that a cheese generates mites without the egg. The growth of animals and vegetables seems to be nothing more than a gradual unfolding of their parts till they obtain their full size. Though water, by merely standing a few days, will be found to contain them, yet they will not be found in any degree so numerous as when vegetable bodies have been steeped therein, for no

living creatures seem to subsist upon water alone; but when it is stored with their proper food, myriads may be found in every drop, of the greatest variety in their forms; some are round, some oblong, and others spherical, and the greatest part of them transparent: motion seems to be their greatest delight; they pervade with ease and the greatest rapidity the whole dimensions of the drop of water, in which they find ample space; sometimes they dart forwards, and at others move obliquely, then again in a circle, and though hundreds may be seen in a single drop, yet they never strike against one another: they differ in their size; some are barely visible to the eye; some so minute as to resist the action of the microscope, and appear only as moving points; of this description is the monus; it is so extremely delicate and transparent as sometimes to elude the highest magnifying power: some are no doubt inhabitants of the water, and others turn into small flies, and deposit their eggs in any kind of fluid producing proper nourishment for their young; the eggs being hatched, they live a certain time in this element, then take wing after a complete change in their forms; this may often be observed, for when they grow to a certain size, of a sudden you will find them gone, and a small race supply their place.

As these infusions to produce them, are all prepared in a similar manner, and as the two following substances may be procured without much trouble, and generate the most remarkable subjects, we shall describe the necessary preparations.

Hay. The infusion of hay produces the greatest variety of animalcules, and by far the most curious; all those described in the plate may at different times be found in this infusion. Twist up a little hay, and press it down into a teacup or any other vessel; cover it with water to the top, and if it absorbs the water, put fresh in; in a few days, in summer, a scum will appear on the top; take from the surface, with the spoon at the end of the forceps, a single drop, and place it between the glasses; it will be found to contain extremely minute animalcules: in a few days they increase in size, and in about ten days they obtain their full growth. It is impossible to enumerate the variety that may be discovered at different times in this infusion; the most numerous are in the shape of an egg, fig. 1. Pl. 8. and with a high power a great number of small feet may be discovered, and at the head a number of fabrilla, which are continually in motion, creating a vortex in the water which brings their prey towards them, which may be discerned many hundred times less than themselves; they use their legs in running as well as swimming, for by placing a human hair across the water, as fig. 2, a number of them will be seen running along

it. We shall find another sort in the shape of a soal, without the appearance of any legs, fig. 3; and many others, which are described in the following pages. The eggs or spawn may be seen, with a high power, attached to any small portion of matter in the drop of water.

PEPPER. Put common black pepper bruised into an open vessel, enough to cover the bottom, pour water upon it about an inch deep, stir them together when first mixed, and afterwards let them remain still. In a few days, in warm weather, a scum will appear on the top; take a single drop from the surface, and place it on the glass. It sometimes happens that such multitudes are in a single drop, that it becomes quite opaque; in this case, dilute it with a drop of pure water.

The following substances produce different descriptions of animalcules:—senna, Indian wheat, cabbage, raspberry stalks, all kinds of flowers, grasses, &c., oatmeal, bran, &c. Also water in which flowers have been standing for any length of time.

BELL-SHAPED POLYPE. During all the months in summer, and particularly in April, a great abundance of these curious insects are to be found on the shells of the small water-snail, duck-weed, and other water plants, and on the larvæ of the larger insects, in such multitudes at times, as to appear like a fine down upon them; they are extremely minute, and generally fasten themselves by their tails in groups of twenty or more, extending themselves in every direction, in search of food, and are not unlike a bunch of tulips; they spring back with a sudden contraction, which is no doubt when they have caught their prey; if they are touched or disturbed, the whole of them contract themselves, as fig. 24. The various species are nearly alike, as to the above particulars, but greatly differ with regard to their size; but none are more interesting than those shown in the plate, fig. 6; when these little animals stretch themselves out, and open their anterior ends, each appears like a bell, with a rim or lip furnished with a number of fibrelle, and vibrate so quickly, that it requires a strong power to see them; it creates a vortex in the water, which reaches to a great distance, in proportion to its size. But though they are found thus joined together in colonies, each head is a perfect insect, and can detach itself from the rest, live separate, and become the parent of a new colony, as most of them do after a certain time; for by attentively examining them, they may be seen swimming about the drop of water separately. When a number of them are fixed to a body, they appear of a whitish color to the naked eye, but through the microscope transparent, with spots upon them.

BELL-SHAPED POLYPE FOUND IN HAY. After hay has been

infused for some weeks in water, an extremely minute bell-shaped polype is found, among a variety of others, as in fig. 4, and requires the greatest power of the microscope to discover their form, for their tails must be many thousand times less than the finest hair of the head. As seen in the plate, they are magnified in bulk six thousand four hundred times, whereby we may form some conception of their minuteness; yet small as they are, they live upon animalcules many hundred times less than themselves.

THE SMALL SNAIL WITH SPIRAL SHELL. This description of snail may be procured in ponds and ditches: the more transparent the better. They may be kept alive for months in a large glass vessel; and it is common for them to fasten their spawn in little masses against the sides of the glass, where the eggs hatch in about three weeks or a month. The spawn appears like a transparent jelly; but, examined by the microscope, you may discover a number of oval pellucid bodies, having each of them a dark speck: this speck becomes a perfect snail, and, a few days before hatched, may be seen, in a perfect state, turning about in the fluid that encloses it; the heart also may be distinctly seen, the pulsation proceeding under the eye with great exactness and regularity, forming a most beautiful spectacle; a number of the bell-shaped polype generally attach themselves to the snail.

THE PROTEUS. None of the many different animalcules I have yet examined have afforded so much pleasure, perplexity and surprise, as the curious insect I am about to describe, which has so wonderful a capability of assuming different shapes, that nobody without actually seeing its changes would believe it to be the same creature; it may be found in water where any kind of vegetable bodies have been infused, and has stood for several weeks: if it is in any glass vessel, a slimy substance will be collected about the sides; some of this being taken off with the point of a knife, and placed on the slip of glass in a drop of water, it will be found, upon looking at it through the microscope, to harbor several kinds of animalcule; the proteus will most likely be seen among them, and is thus described by Mr. Baker:—'After having been examining some of this matter for sometime, which I found plentifully stocked with various kinds of animalcules, a little creature suddenly made its appearance among them, whose figure was entirely new to me, moving about with great agility: the body was elliptical, with a slender fine-proportioned neck, similar to a swan's. Fig. 19 is a representation of this extraordinary insect. It moved its head backwards and forwards, seemingly in search of its prey. After viewing it for sometime with a low power, wishing to change it for a greater, which took up sometime, it was lost to view, and

nothing was seen the least resembling it. Some weeks after, examining some more of this slimy matter, again the same kind of insect made its appearance; after watching it for sometime, it suddenly changed its form,—it drew in its neck, and only the body appeared; another change then quickly took place,—it thrust out its head, as in fig. 20, with wheel-work machinery.

THE MONOCULUS, OR WATER-FLEA. So numerous is this insect in the summer months, that the waters will appear tinged, sometimes red and at others green, owing to myriads of these insects upon the surface. It is the size of the common flea when full grown, but is a much better object for the microscope when young, as it is then not larger than a mite, but much more transparent, and the motion of the inside is clearly visible. The pulsation of the heart may also be distinctly seen. Its head is extremely small, and the eye is situated on the trunk. It has two arms, or legs, which it waves as a bird moves its wings, and, by striking the water, it rises or descends with great rapidity.

THE HYDRA, OR POLYPE. The nature of this insect is extremely singular, and contrary to the general principle of life; for if the polype be cut into any number of pieces, each piece will become a perfect creature, having all the functions of animal life. Hydra were first discovered by Mr. Trimley, who took them for plants, and saw, as he imagined, young shoots or branches coming out; at last he perceived them devour smaller insects; he cut one of them in two, and, in a few days, new arms were growing out of the part he had cut away; these insects have since been divided in every way with similar effect. The green polype, which is most common in this country, is about half an inch in length, and its arms are placed in a circle round its mouth. This kind is found crawling on the ground in clear running water, or on water plants, hanging by its tail, and extending its arms in search of food. The hydra, or polype, (put into a glass vessel with other water insects and a quantity of duck-weed,) may be kept alive for months.

THE EPHEMERA. This is another curious insect in the larva state, and is found either in ponds, or among the aquatic weeds that grow by their side. The ephemera, in its perfect state, which is that of a fly, seldom exists more than one day; within this short period it performs all the functions of other insects, and then expires. There is a great variety of this tribe, all very beautiful; the most common species is found in gardens, and is a slender-bodied fly, of a grass-green color, with large bright gold eyes and four wings. It is about the size of a large common gnat. Great care is requisite in securing them, as they are extremely

tender; the best way of holding them for examination by the microscope, is by the wings, in the spring forceps. When they are in the larva state, a watch-glass half filled with water is the most convenient; the smallest species are best adapted for this purpose, as being the most transparent; they have seven paddles on each side.

LUMINOUS WATER INSECTS. The Rev. Mr. Baker, in his observations on luminous insects in water, says that he has been surprised sometimes at the sparks of light to be seen on the shells of oysters, on removing them, when fresh taken from the sea. He bestowed some pains to find out the cause, and was perfectly convinced, after many examinations, that it arises from a minute insect, the length of which is about one eighth of an inch: the head is armed with a pair of forceps; the body consists of twenty-eight joints or divisions, each having a pair of feet belonging to it. This little insect can èmit or conceal its light, and is very similar to the glow-worm.

SEA-WATER. Another account is given by Dr. Veanella, of Chioggea, in Italy. In his inquiry into the shining of sea-water in the night, which he says is seen with wonder in the lakes of Chioggea, where sea-weeds abound, he relates that he brought from thence, one summer's night, a bottle of the water, which, being stirred in the dark, sparkled; but, after being filtered through a cloth, afforded no light at all, while the cloth was covered with shining particles, which, being examined by the microscope, were discovered to be living insects, formed something like a caterpillar, with ringlets on the body; from the head issued two horns, and the tail appeared twisted. These insects are entirely luminous, and when at rest do not shine at all, but send forth a great light as soon as they become agitated.

VORTICELLA, OR WHEEL INSECT. This surprising insect is found in leaden gutters, not exceeding the size of a grain of sand; you may often discover it in ponds, ditches, upon duck-weed, &c., and in water that has stood sometime in vessels in the house, adhering to the sides, and in the infusion of hay: if the water or the sediment in gutters has a red appearance, you will most likely find some: the minuteness of these insects makes it impossible to know whether you have them or not without examination with the glasses. The best way of discovering them is by placing some of the sediment under the low power of the microscope. If you find any there, then screw on a higher power, and watch their motions with attention. This little creature shows itself first like a transparent maggot, lengthening out its body at times, and at others contracting it,—changing again its form in an instant, as figs.

9 and 21. Every part seems capable of great extension and contraction: to examine the wonderful mechanism of its parts will afford hours of amusement; it being transparent, the motion of the heart and other internal parts may be seen: it appears continually to be hunting after its prey, has a large mouth, and is furnished by nature with an amazing piece of machinery or wheel-work to procure its food; the wheel-work projects from the head, and turns round with great velocity, causing a rapid current of water to be brought from a considerable distance to its mouth, and by this means supplying it with food; as these wheels are transparent, it is very difficult to determine by what contrivance they move, or what their real figure is. Though they seem exactly to resemble wheels moving round upon an axis, as the insect is capable of thrusting these parts out or drawing them in at pleasure, their figure is completely altered by so doing, and they appear in the various forms represented in figs. 8, 9, 10.

Sometimes they turn themselves into round globules or balls, when done feeding: they then draw in their wheels, and their tails remain fastened to the slip of glass they were placed on, as in fig. 7. All their actions seem to imply sagacity and quickness of sensation, for at the least touch or motion in the water, they draw in their wheels: though small creatures, they may be compared to whales in proportion to some of the animalcules in the same drop of water; these are their prey, which they draw towards them by the current of water which their wheels excite, fig. 9. None of them can cross this current without being drawn into its mouth. Some of them have eggs or spawn attached: and by procuring a number of them, and watching them attentively, the young one may be seen to burst the egg, and gradually force its way out, fig. 12, in doing which, it is greatly assisted by the tail of the parent, for by moving it to and fro, and striking the shell, it breaks the egg, and the young one, by the assistance of its wheels, is thus enabled to force its way.

A small species of the wheel insect is found in the infusion of hay, after sometime standing, as in fig. 5. This animalcule possesses the wonderful property of retaining life for years when out of the water; in this state, life may be said to be latent, but, shortly after the insect is placed in water, it resumes its functions and becomes as active and vigorous as before.

THE SATYR, OR SMALL WATER SPIDER In ponds, and in several infusions, a little crustaceous insect is to be found, fig. 13. The shell is so exceedingly transparent, that it can hardly be discerned—it covers the whole of its back. Four legs or fins

serve it to walk or swim; but it generally creeps along at the bottom of the drop.

Fig. 14 represents an aquatic animal; its appearance to the naked eye is like a slender worm, about one tenth of an inch in length, but the microscope shows its real form; from the head a long proboscis extends, and is moved every way with great readiness; the head is of a yellowish color, the rest of the body transparent, and long tufts of hair grow from it; the blood circulates in the middle of the body, running towards the tail.

Paste Eels. Those who are desirous to be furnished with a curious living object for the microscope, should be provided with the eels in paste: they are, after the paste has been made for some weeks, so numerous, that the whole surface of it appears alive, and by taking from the surface with a point of a needle the smallest particle, and putting it in a drop of water, it will be found to contain a number of these minute eels, fig. 17, with a continued regular motion swimming about the drop of water. A curious experiment may be performed by separating one of the larger sort from the rest; by placing it in another drop of water by means of a fine point of a quill; it may then be easily cut asunder by a fine lancet, and if the division is made about the middle of the animal, several oval bodies will be seen to come forth, as in fig. 18; these are the young, curled up in a fine membrane: the largest and most forward break through it, unfold themselves, and swim away; numbers have been seen to issue from one single eel, which accounts for their great increase. The question is, by what means do they first get into the paste; if an egg were in the flour, the operation of boiling the paste would certainly destroy them, but it is a most extraordinary fact, that they will live in a degree of heat above one hundred; and in paste too hot to bear the finger in. In viewing the paste eel with deep powers, there is no necessity to produce an elevation between the glass and the talc, as the paste although diluted with water, answers that purpose—place a drop of water upon the glass, into which introduce a small quantity of the paste, covering both with a very thin piece of talc: prepared in this way, any power may be applied with effect: in fact, the paste eel is a good object for the deepest powers.

Vinegar Eels. A small eel may likewise be found in the dregs of vinegar, that moves much quicker than the above.

Eels in Blighted Wheat. These animalcules are not usually lodged in such blighted grains of wheat as are covered externally with a soot-like dust; but abundance of ears may be observed in some fields having grains that appear blackish, as if scorched, and, when opened, are found to contain a soft white substance.

This, examined attentively, seems to be nothing else but a knot of threads lying as close as possible to each other; this fibrous matter discovers no sign of life, but, upon applying water to it, the supposed fibres separate, and prove to be living creatures, by motion at first languid, but gradually more vigorous.

THE GLOBE ANIMAL. Fig. 15 represents this very singular water animal, as it is seen before the microscope; its form seems exactly globular, having no appearance of head or tail; it moves in all directions, sometimes slow, and at other times very swift, then swimming like a top; the surface of the body seems dotted all over with little points, and beset round with hairs, which are no doubt their means of motion.

CONCHOLOGY.

NO. VI.

OF THE PRODUCTION OF PEARLS. In treating of the constituent parts of shells, it was observed that the composition of the pearls, appears, from analysis, to be precisely the same as the mother-of-pearl, or those shells in which the pearl is usually found. From this we must conclude, that the pearl, and the mother-of-pearl, are produced by the same secretion. It appears, from the observations of naturalists, and indeed it might have been expected, from the similarity of composition, that all testaceous animals, whose shells come under the description of mother-of-pearl, occasionally produce pearls.

Different opinions have been entertained with regard to the cause of the formation of this precious production. According to some, it is merely a morbid concretion, formed within some part of the body of the animal, or at least within the shell, without any apparent external injury; while others suppose that it is only owing to wounds which the shell, or the animal, or both, have received from accidental causes, or from the action of insects or some testaceous animal, making perforations in the shell. It is not improbable that pearls may be formed in both ways.

Every day's experience informs us, that similar concretions are formed in different cavities of the bodies of other animals, but without any obvious cause, or external injury. The formation of such concretions, as, for instance, biliary and urinary, calculi, producing the most excruciating disorders in the human body, are

too fatally known. These concretions, no doubt, owe their origin to the diseased or unhealthy action of the vessels secreting the fluids in which they are formed. By this diseased action producing a super abundance of the matter, which enters into the composition of the concretion; or this matter in the fluid state, meeting with some solid body, which becomes a nucleus, is attracted by it, and deposited in concentric layers, till the concretion acquires a larger or smaller size, according to the duration and quantity of the secretion and deposition. In the same way, it seems extremely probable the pearl may be frequently formed; the matter of which it is composed, being constantly secreted by the animal for the production of the new part of the shell. If then, this matter should at any time be produced in greater quantity than what is necessary to form the inner layers of the shell, and particularly if it should meet with a solid particle of any body, it will be attracted by it, and thus constitute the rudiments of a pearl, which will receive constant additions of concentric layers, and increase in size, in proportion to the age of the animal, and the quantity of matter deposited. Pearls, it is said, have been found within the body of the animal. If this be true, the pearly matter, in its passage through the vessels of the body, must have met with some nucleus, around which the concentric layers have been founded. In most cases, however, the pearl is found loose in the shell, entirely detached from the animal. It must then have been formed of the matter, which was thrown out of the body, but it is not unlikely that pearls are found both ways, or that the same pearl may be partly formed within the body of the animal, and be afterwards excluded, and arrive at its utmost size, while it remains loose in the shell.

But according to others, the pearl owes its formation to some external injury. The following seems to be a pretty distinct view of this opinion. When Taujas de St. Fond visited Loch Tay, he was led to make some inquiries concerning the pearl fishery, which had been carried on in several parts of the river Tay for some years. Shells were brought to him, and in these shells the fishermen pretended to find pearls, which they expected to sell at a higher rate, as they were found in the presence of the traveller. But he informs us, that they attempted to impose on him, by introducing a pearl secretly into the shells as they opened them. Observing this circumstance, he told them that he could know at once, by examining the outside of the shell, before opening it, whether it contained any pearl. He mentions this to introduce some speculations concerning its formation. When no perforation or callosity appeared on the outside, he concluded that there was

no pearl in the shell. The pearl fish, he supposes, is attacked by two classes of enemies. One is what he calls the *anger worm* which penetrates into the inside, near the edge of the valve, by making a longitudinal passage, between tbe layers of the shell. The length of the channel is one inch, or one inch and a half, when it doubles back in a line parallel to the first. At the inner extremity there is a small circular portion formed by the worm in turning round. These excavations are in the pearly part of the shell. The pearly juice extravasating, forms protuberances in the same direction; and the cylindrical bodies which are thus formed, may be considered as elongated pearls, adhering to the internal surface. When several worms of this kind, unite their labors, by penetrating near each other, the result is a kind of pearls, even with irregular protuberances.

Another sea worm, which he says belongs to the multivalves, a species of pholas, also attacks the pearl shells. The shell of this species of pholas has a hinge in the form of a crooked bill, as he saw in some species of oyster, which he examined, from the coast of Guinea. The hole was of the shape of a pear. Pearls of this shape have been found, and have been held in great estimation. Observing this circumstance, artificial perforations are made in the shell, and this forces the animal to produce pearls. In some shells brought from China, this artificial hole has been observed filled up with brass wire, rivetted on the outside like a nail, and the inner extremity of the wire with a well-formed pearl, which seemed as if soddered to its extremity.

Pearls are also produced by another artificial process. The shell is opened with great care, to avoid injuring the animal, and a small portion of the internal surface of the shell is scraped off. In its place is inserted a spherical piece of mother-of-pearl, about the size of a small grain of lead shot. This serves as a nucleus, on which is deposited the pearly fluid, and in time forms a pearl. Experiments of this kind have been made in Finland, and have been repeated in other countries.

A remarkable discovery has been ascribed to Linnæus respecting the generation of pearls. This was a method which he found out, by putting the pearl muscle (*Mya margaritifera*) into a state of producing pearls at his pleasure. It was some years, before the final effect could take place; but in five or six years after the operation, the pearl, it is said, had acquired the size of a vetch. But it does not seem to be known in what this operation consisted. Whether it consisted in imitating the process of insects, by wounding the shell from the outside, or by following the other process, by scraping away part of the inner layer; nor is it much known

what have been the effects of this operation, or whether it has turned to any account, or indeed is it at all practised in Sweden or in any of the northern states where it must have been originally known. For this discovery however, the Swedish naturalist, it is said, was raised to the rank of nobility, and otherwise liberally rewarded by the states of the kingdom.

The valve which is put on the pearl, depends on its size, color, shape, and purity. The largest pearls are always held in the highest estimation, when their other qualities are in any degree of perfection. The finest shape of the pearl must be quite globular; it must be of a clear brilliant white, smooth and glossy, and entirely free from spot or stain. Pearls were greatly esteemed, and much sought after by the Romans. Servilia, the mother of Marcus Brutus, we are informed, presented a pearl to Cæsar, which was valued at 50,000 lbs sterling; and Cleopatra dissolved one, which is said to have been worth 250,000 lbs sterling, in vinegar, which she drank at a supper with Mark Antony.

ORNITHOLOGY.

NO. VIII.

Flight of Birds. The flight of birds differs exceedingly; some fly by jerks, closing their wings every three or four strokes, which gives them an undulated motion, very conspicuous in the woodpeckers and wagtails, and in most small birds; others fly smooth and even; and some appear to buoy themselves in the air without perceptible motion of the wings, such as the kite and hawk. Most birds fly with their legs contracted, with their neck extended; but there are some whose length and weight of neck makes it necessary to contract it in flight, in order to bring the centre of gravity on the wings; to aid which the legs are also extended behind, as in the heron and bittern; others fly with extended neck, but are obliged to throw out their legs behind as in the duck, goose, and other water fowl.

It is recorded that a falcon belonging to Henry IV., King of France, which escaped from Fontainbleau, and in twenty-four hours after was found in Malta, a space computed to be not less than 1350 miles, a velocity equal to 57 miles an hour, supposing the hawk to have been on wing the whole time. But as such birds never fly by night, and allowing the day to be at the longest,

or to be of eighteen hours' light, this would make seventy-five miles an hour. It is probable, however, that he neither had so many hours of light in the twenty-four, to perform the journey, nor that he was retaken at the moment of his arrival, so that we may fairly conclude much less time was occupied in performing that distant flight.

Those who have attended to the flight of birds, know that a sparrow will fly at the rate of more than thirty miles an hour. It is indeed extremely difficult to ascertain the actual distance a falcon may fly in a given space of time, when in pursuit of its quarry. It has been estimated, however, that one in pursuit of a snipe flew nine miles in eleven minutes, independent of the numerous turns; and the force with which they strike, in the utmost of their velocity, is so great, that a hawk has been known to cut a snipe in two parts.

The rapidity with which a hawk, and many other birds occasionally fly, is probably not less than at the rate of one hundred and fifty miles an hour, when either pursued or pursuing, and their powers fully exerted; and certainly one hundred miles is not beyond a fair computation for migratory continuance, not only of the hawk, but of the woodcock, snipe, and other similar birds. Some years ago an experiment was made in the vicinity of Portsmouth, N. H. with a pigeon, to ascertain the rapidity of her flight. She was taken from her young and carried to the distance of eighty miles into the country. After she had been kept there for several days, she was liberated; and no sooner was she out of the hands of her keeper, than she made her way vertically into the air with the velocity of lightning, and shortly disappeared. In about forty-five minutes after, she was seen at the side of her nest feeding her young ones.

Among quadrupeds, the horse is perhaps as fleet as any, and yet the velocity falls very short of that of a bird; the famous racer, *Hambletonian*, covered a space of four miles in eight minutes, which is but thirty miles an hour, if it could be continued. *Eclipse* is said to have gone at the rate of a mile a minute for a short distance.

THE MOCKING BIRD.

(*Turdus polyglottus*, Lin. Wilson, ii. p. 13. pl. 10. fig. 1. Audubon, pl. 21. [a spirited group and nest attacked by a rattlesnake.] *Orpheus polyglottus*, Swainson. Philad. Museum, No. 5288.

Specific Characters.—Cinereous; beneath whitish; tips of the wing-coverts, primaries at base, and lateral tail-feathers, white; tail cuneiform.

This unrivalled Orpheus of the forest, and natural wonder of America, inhabits the whole continent, from the state of Rhode Island to the larger isles of the West Indies, and continuing through the equatorial regions, is found in the southern hemisphere as far as Brazil. Nor is it at all confined to the Eastern or Atlantic states. It also exists in the wild territory of Arkansa more than a thousand miles from the mouth of Red River. It breeds at the distant western sources of the Platte, near the very base of the Rocky mountains;* and Mr. Bullock saw it in the table land of Mexico. The mocking bird rears its young, and consequently displays its wonderful powers, in all the intermediate regions of its residence in the United States to the peninsula of Florida.† It appears, in short, permanently to inhabit the milder regions of the western world in either hemisphere;‡ and the individuals bred north of the Delaware, on this side the equator, are all that ever migrate from their summer residence. A still more partial migration takes place also, probably, from west to east, in quest of the food and shelter which the maritime districts afford. Though now so uncommon in that vicinity, fifty or sixty years ago, according to Bartram, they even wintered near Philadelphia, and made a temporary abode in the mantling ivy of his venerable mansion. In summer, a few proceed as far as Rhode Island, following the mild temperature of the sea coast; but further north, they are, I believe, nearly unknown, except rarely and occasionally in Massachusetts. With the advance of the season, also, in the country which it inhabits, varies the time of incubation. Early in April they begin to build in the maritime parts of Georgia, but not before the middle of May in Pennsylvania.

In the winter season they chiefly subsist on berries, particularly those of the Virginia juniper (called red cedar,) wax myrtle, holly, smilax, sumach, sour gum, and a variety of others, which fur-

* Mr. Say. † Mr. Ware.

‡ Mr. Litchfield informs me, that the song of the mocking bird is commonly heard in Venezuela, where of course it breeds and permanently resides.

nish them, and many other birds, with a plentiful repast. Insects, worms, grasshoppers, and larvæ, are the food on which they principally subsist, when so eminently vocal, and engaged in the task of rearing their young. In the Southern States, where they are seldom molested, with ready sagacity they seem to court the society of man, and fearlessly hop around the roof of the house, or fly before the planter's door. When a dwelling is first settled in the wilderness, this bird is not seen sometimes in the vicinity for the first year; but, at length, he pays his welcome visit to the new comer, gratified with the little advantages he discovers around him, and seeking out also the favor and fortuitous protection of human society. He becomes henceforth familiar, and only quarrels with the cat and dog, whose approach he instinctively dreads near his nest, and never ceases his complaints and attacks until they retreat from his sight.

On the 26th of February I first heard the mocking bird, that season, in one of the prairies of Alabama. He began by imitating the Carolina woodpecker, *tshooai tshooai, 'tshow 'tshow 'tshow;* then, in the same breath, the *sweetoot sweetoot* of the Carolina wren; by and bye, *woolit woolit 'tu 'tu* of the cardinal bird, and the *peto peto peto* of the tufted titmouse, with connecting tones of his own, uttered with an expression so refined and masterly, as if he aimed, by this display of his own powers, to make those inferior vocalists ashamed of their own song. It was truly astonishing what a tender sweetness he contrived to blend amidst notes so harsh and dissonant as those of the woodpecker, which ever and anon, made, now, the chorus of his varied and fantastic song. In the lower parts of Georgia, by the beginning of March, they are already heard vying with each other, and with the brown thrush, rendering the new-clad forest vocal with the strains of their powerful melody.

Like the ferruginous thrush, to which he is so nearly related, the mocking bird chooses a solitary briar bush or a thicket for his nest; sometimes an orchard tree contiguous to the house is selected for the purpose, at little more than the height of a man from the ground. The composition of this cradle of his species is, generally, an external mass of dry twigs, leaves, and grass, blended with bits of decayed wood, and then surmounted with a thick layer or lining of root fibres of a light-brown color. The eggs are about four or five, pale green, with blotches of brown scattered nearly all over. The female sits fourteen days, usually producing two broods in a season, and is often assiduously fed, while so engaged, by the attentive male. She is jealous of her nest, and complains with a mournful note, their usual low call, when her

eggs have been touched, but does not readily abandon the spot she has once chosen.* None of the domestic animals, or man himself, but particularly the cat and dog, can approach, during the period of incubation, without receiving an attack from these affectionate guardians of their brood. Their most insidious and deadly enemies, however, are reptiles, particularly the black snake, which spares neither the eggs nor young. As soon, as his fatal approach is discovered, by the male, he darts upon him without hesitation, eludes his bites, and striking him about the head, and particularly the eyes, where most vulnerable, he soon succeeds in causing him to retreat, and by redoubling his blows, in spite of all pretended fascination, the wily monster often falls a victim to his temerity; and the heroic bird leaving his enemy dead on the field he provoked, mounts on the bush above his affectionate mate and brood, and in token of victory celebrates his loudest song.

The mocking bird, like the nightingale, is destitute of brilliant plumage, but his form is beautiful, delicate, and symmetrical in its proportions. His motions are easy, rapid, and graceful, perpetually animated with a playful caprice, and a look that appears full of shrewdness and intelligence. He listens with silent attention to each passing sound, treasures up lessons from anything vocal, and is capable of imitating with exactness, both in measure and accent, the notes of all the feathered creation. And, however wild and discordant the tones and calls may be, he contrives with an Orphean talent, peculiarly his own, to infuse into them that sweetness of expression, and harmonious modulation which characterizes this inimitable and wonderful composer. With the dawn of morning, while yet the sun lingers below the blushing horizon, our sublime songster, in his native wilds, mounted on the topmost branch of a tall bush or tree in the forest, pours out his admirable song, which, amidst the multitude of notes from all the warbling host, still rises pre-eminent, so that his solo is heard alone, and all the rest of the musical choir appear employed in mere accompaniments to this grand actor in the sublime opera of nature. Nor is his talent confined to imitation; his native notes are also bold, full, and perpetually varied, consisting of short expressions of a few variable syllables, interspersed with imitations, and uttered with great emphasis and volubility, sometimes for half an hour at a time, with undiminished ardor. These native strains bear a considerable resemblance to those of the brown thrush, with which he is so nearly related in form, habits, and manners; but, like rude from cultivated genius, his notes are distinguished by the rapidity of their de-

* Audubon's Orn. Biog. vol. i. p. 111.

livery, their variety, sweetness, and energy. As if conscious of his unrivalled powers of song, and animated by the harmony of his own voice, his music is, as it were, accompanied by chromatic dancing and expressive gestures; he spreads and closes his light and fanning wings, expands his silvered tail, and, with buoyant gaiety and enthusiastic ecstacy, he sweeps around, and mounts and descends into the air from his lofty spray, as his song swells to loudness, or dies away in sinking whispers. While thus engaged, so various is his talent, that it might be supposed a trial of skill from all the assembled birds of the country; and so perfect are his imitations, that even the sportsman is at times deceived, and sent in quest of birds that have no existence around. The feathered tribes themselves are decoyed by the fancied call of their mates; or dive with fear into the close thicket, at the well-feigned scream of the hawk.

Soon reconciled to the usurping fancy of man, the mocking bird often becomes familiar with his master; playfully attacks him through the bars of his cage, or at large in a room; restless and capricious, he seems to try every expedient of a lively imagination, that may conduce to his amusement Nothing escapes his discerning and intelligent eye or faithful ear. He whistles perhaps for the dog, who, deceived, runs to meet his master; the cries of the chicken in distress bring out the clucking mother to the protection of her brood.—The barking of the dog, the piteous wailing of the puppy, the mewing of the cat, the action of a saw, or the creaking of a wheelbarrow, quickly follow with exactness. He repeats a tune of considerable length; imitates the warbling of the Canary, the lisping of the indigo bird, and the mellow whistle of the cardinal, in a manner so superior to the originals, that mortified and astonished, they withdraw from his presence, or listen in silence, as he continues to triumph by renewing his efforts.

In the cage also, nearly as in the woods, he is full of life and action, while engaged in song; throwing himself round with inspiring animation, and, as it were, moving in time to the melody of his own accents. Even the hours of night, which consign nearly all other birds to rest and silence, like the nightingale, he oft employs in song, serenading the houseless hunter and silent cottager to repose, as the rising moon illumines the darkness of the shadowy scene. His capricious fondness for contrast and perpetual variety appears to deteriorate his powers. His lofty imitations of the musical brown thrush are perhaps interrupted by the crowing of the cock, or the barking of the dog; the plaintive warblings of the blue bird are then blended with the wild scream and chatter of the swallow, or the cackling of the hen; amid the simple lay of

the native robin, we are surprised with the vociferations of the whip-poor-will; while the notes of the garrulous jay, kildeer, woodpecker, wren, fifing Baltimore, and many others succeed, with such an appearance of reality, that we most imagine ourselves in the presence of the originals, and can scarcely realize the fact, that the whole of this singular concert is the effort of a single bird. Indeed, it is impossible to listen to these Orphean strains, when delivered by a superior songster in his native woods, without being deeply affected, and almost rivetted to the spot, by the complicated feelings of wonder and delight, in which, from the graceful and sympathetic action, as well as enchanting voice of the performer, the eye is no less gratified than the ear. It is, however, painful to reflect, that these extraordinary powers of nature, exercised with so much generous freedom in a state of confinement, are not calculated for long endurance, and after this most wonderful and interesting prisoner has survived for six or seven years, blindness often terminates his gay career; and thus shut out from the cheering light, the solace of his lonely but active existence, he now, after a time, droops in silent sadness and dies.

Successful attempts have been made to breed this bird in confinement by allowing them retirement and a sufficiency of room. Those which have been taken in trap cages are accounted the best singers, as they come from the school of nature, and are taught their own wild wood notes. The prices of these invaluable songsters are as variable as their acquired or peculiar powers, and are from five to fifty dollars; even a hundred has been refused for an extraordinary individual. The food of the young is thickened meal and water, or meal and milk, mixed occasionally with tender fresh meat, minced fine. Animal food, almost alone, finely divided and soaked in milk, is at first the only nutritive food suited for raising the tender nurselings. Young and old require berries of various kinds, from time to time, such as cherries, strawberries, whortleberries, &c., and, in short, any kind of wild fruits of which they are fond, if not given too freely, are useful. A few grasshoppers, beetles, or any insects conveniently to be had, as well as gravel, are also necessary; and spiders will often revive them when drooping or sick.

The young male bird, which must be selected as a singer, may be distinguished by the breadth and purity of the white on the wings. This white spot, in a full grown male, spreads over the whole nine primaries, down to, and considerably below their coverts, which are also white, sometimes slightly tipt with brown. The white of the primaries, also, extends to the same distance on both vanes of the feathers. In the female, the white is less

clear, spreads only over seven or eight of the primaries, does not descend so far, and extends considerably farther down on the *broad* than on the *narrow* side of the feathers. The black is also more inclined to brown.

The length of the mocking bird is nine and a half inches, and thirteen in alar extent. Individuals of the first brood in the season are larger and more robust than those produced later. Above ash-color, at length inclined to brown. The wings and tail nearly black, the first and second rows of coverts tipt with white; the primary coverts in some males are wholly white, in others tinged with brown. The three first primaries are white from their roots as far as their coverts; the white on the next six extends from an inch to one and three fourths farther down, and equally on both sides of the feather. The tail is wedge-shaped, the two outer feathers white, the rest, except the middle ones, tipt with white. Chin white; the remaining parts below, a brownish white, and clearer in wild than domesticated birds. Iris inclining to golden, but lighter. Bill, legs, and feet black; the base of the lower mandible whitish. The difference in the female is already given. The breast of the young is spotted like that of the thrush.

[The preceding article is from Mr. Nuttall's excellent work on Ornithology, which we had the pleasure of recommending to the notice of our readers a few months ago. We think it ought to be in the hands of every person who is forming a library, and sincerely wish that its circulation will be such as to amply pay the industrious and indefatigable author for his pains.]

MOUBRAY ON POULTRY.

[A Treatise on Breeding, Rearing, and Fattening, all kinds of Poultry, Cows, Swine, and other Domestic Animals. By B. Moubray, Esq. Reprinted from the sixth London Edition. With such Abridgements, and Additions, as, it was conceived, would render it best adapted to the soil, climate, and common course of culture, in the United States. By Thomas G. Fessenden, Esq. Editor of the New England Farmer; 12 mo. pp. 266. Boston: Lilly and Wait, Carter and Hendee.]

We are much gratified with the appearance of this useful work, and can safely recommend it to our agricultural friends, both from the abilities of the authors, and the importance of the subject as being highly deserving of patronage. The American author observes in his preface, that, 'The popularity, and extensive sale of *Moubray's Treatise on Poultry*, &c, afford infallible proofs of the

estimation in which it is held by the British public; and would seem to render an apology for reprinting it *verbatim*, in the United States, unnecessary. But a mere *copy* of the last English edition would embrace much matter, which could scarcely interest or amuse an American reader. A considerable part of the original work consists of local, personal, and transient topics;—of tales and anecdotes, the perusal of which would afford no profit, and not much amusement to readers in quest of *useful* information. These are omitted in the following work, and their place supplied by articles, original, or selected from the most authentic sources.' In treating of augmenting the quantity and quality of the food of animals, he remarks as follows:—

'The importance of *cooking* food for animals is not generally so well appreciated as it ought to be; nor is the principal cause or source of improvement, as well in quality as quantity of cooked food over its raw materials, known to every economist. The researches and deductions of philosophers and chemists, assure us that *water* supplies *food* for animals as well as plants. But, in order that water may yield its best and greatest effect as nutriment either for man or beast, it is necessary to *cook* it, or increase its nutritive powers, by the agency of heat; by which water, when combined with certain substances of vegetable origin, is converted into wholesome, palatable, and often *solid* food.

'It is a fact, which will be acknowledged as soon as stated, that a pound of Indian meal, of rice, or any other farinaceous substance, when boiled, contains more nourishment than several pounds in a raw state. Count Rumford has stated that "From the results of actual experiment it appears that for *each pound* of Indian meal employed in making a pudding, we may reckon *three pounds nine ounces* of the pudding.* And again, three pounds of Indian meal, three quarters of a pound of molasses, and one ounce of salt (in all three pounds thirteen ounces of solid food) having been mixed with five pints of boiling water, and boiled six hours, produced a pudding which weighed *ten pounds and one ounce.*†" Thus we gain from the raw material about three hundred per cent. in weight, and, no doubt, the gain as respects the quantity of nutriment contained in the pudding, over and above the component parts as they existed before boiling, was still greater. The gain of weight in rice, in consequence of boiling, is still more considerable than that of Indian meal, and every one knows that a small quantity of oatmeal, will produce a very great relative proportion of gruel.

'I will give other examples, proving that water is not only capa-

* Rumford's Essays, vol. i, p. 253, Boston ed.
† Rumford's Essays, vol. i, p. 264, Boston ed.

ble of being converted by heat into solid nutriment, but may be made to compose a constituent part of sugar, one of the most nutritious of substances. It is remarked by De Saussure, that, "As starch boiled in water with sulphuric acid, and thereby changed into sugar increases in weight, without uniting with any sulphuric acid, or gas, or without forming any gas, we are under the necessity of ascribing the change wholly to the *fixation or solidification of water.* Hence we must conclude that *starch sugar is nothing else than a combination of starch with water in a solid state.* The sulphuric acid is not decomposed nor united with the starch as a constituent."

'It appears, likewise, that Capt. Palter, of Sackett's Harbor, at the instance of Samuel Guthrie, of the same place, has succeeded in the manufacture of sugar from the potatoe; and a detail of the process by which this is effected, is given in Professor Silliman's Journal of January, 1832. It is there said that—

"A bushel of potatoes weighs about sixty pounds, and gives eight pounds of pure, fine, dry starch. This amount of starch will make five pints of sugar, of the weight of nearly twelve pounds to the gallon, equal to seven pounds and a half to the bushel of potatoes, or a little less than a pound of sugar to a pound of starch. The sugar is not so sweet as the Muscovado sugar, nor is it actually so sweet as its taste would indicate.

"This sugar may be used for all domestic purposes. It ferments with great liveliness and spirit, when made into beer, yielding a healthful and delicious beverage, and on distillation a fine cider-brandy flavored spirit. It would, however, be most useful in making sweetmeats, and may be used upon the table instead of honey, for which it is a good substitute. It has already become a favorite with most people who have become acquainted with it. Its taste is that of a delicious sweet, and as an article of diet is unquestionably more healthful and less oppressive to the stomach than any other sweet ever used."

'The elements or chemical constituents of starch, and of sugar, are nearly the same. According to Mr. Gay Lussac and Thenard, one hundred parts of starch are composed of

Carbon, with a small quantity of saline and earthy matter,	43.55
Oxygen,	49.68
Hydrogen,	6.77
	100.00
or, Carbon,	43.55

Oxygen and hydrogen in the proportion neces-

sary to form water, 56.45

'Lavoisier concluded from his experiments that sugar is composed of the following elementary proportions in a hundred parts:—

28 carbon,
8 hydrogen,
64 oxygen.

Then to turn starch to sugar it is merely necessary to subtract from the carbon of the starch, to wit, 43.55, 15.55, and it will stand 28 carbon.

To add to the oxygen of the starch, to wit, 49.68, 14.32, and it is 64 oxygen.

To add to the hydrogen of the starch, to wit, 6.77, 1.23, and it is 8 hydrogen.

Thus, by adding oxygen and hydrogen to starch, in certain proportions, and by subtracting or driving off as much carbon as will be equivalent to the additions, starch is changed to sugar. Water is composed of oxygen and hydrogen, and, together with the sulphuric acid, furnishes the elements necessary for the change, by the agency of the same heat which expels a part of the carbon.

'Should any person still doubt whether water can exist in a solid state, combined with other substances, but not frozen, let him take the trouble to weigh a small quantity of quick lime, then slake it with water, and mark its increase of weight.

'Braconnet, a celebrated chemist, raised vegetables in pure river sand, in litharge, in flowers of sulphur, and even among metal, or common leaden shot; and in every instance nothing was employed for their nourishment but *distilled water*. The plants throve, and passed through all the usual gradations of growth to perfect maturity. The author then proceeded to gather the entire produce, the roots, stems, leaves, pods, &c. These were accurately weighed, then submitted to distillation, incineration, lixiviation, and other ordinary means used in careful analysis. Thus he obtained from the vegetables all the materials peculiar to each individual species, precisely as if it had been cultivated in its own natural soil;—viz. the various earths, the alkalies, acids, metals, carbon, sulphur, phosphorus, nitrogen, hydrogen, &c. He concludes this important paper with these remarkable words:—"Oxygen and hydrogen, with the assistance of solar light, appear to be the only elementary substances employed in the constitution of the whole universe; and nature in her simple progress, works the most infinitely diversified effects by the slightest modification of the means she employs."

'This chemist entertained an opinion founded on experiment, that the elements of water composed plants, the decay of plants

formed the materials which constitute the earth; and of course the "Great Globe and all which it inherit," so far as natural causes are concerned, are products of the modification and fixation of water. Other philosophers assure us that the remains of marine animals, &c, are found on the highest mountains; and that there are many and incontrovertible proofs that the solid parts of the globe have gained on its waters, not only within the limits of authentic history, but in some cases within the memory of man.'

CABINET CYCLOPÆDIA.

SILK MANUFACTURE.

NO. VIII.

ATTEMPTS TO SUBSTITUTE OTHER FOOD FOR MULBERRY LEAVES IN REARING SILKWORMS. 'It must always be a subject of anxious attention with the rearer of silkworms so to time the hatching of his eggs as to cause the coming forth of the living insects at the season when the mulberry tree first comes into leaf.

'By the aid of artificial means, and with methodical arrangements, this would appear to be a very simple affair; and yet, so great have the difficulties been in practice, that various expedients have from time to time been proposed and attempted for combating them.

'Great industry has been employed to seek out some substitute for the natural food of the worm, which should be readily procurable at all seasons, and in sufficient abundance to render the cultivator independent of the chances which attend the budding of the mulberry tree. Dr. Lodovico Bellardi, a learned and ingenious botanist of Turin, after making numerous experiments, and failing to discover any elligible substitute for the mulberry, at length proposed a method of feeding such silkworms as should be prematurely hatched, upon leaves of the preceding season carefully dried and prepared for the purpose. The trials made by the doctor were accompanied by all the success he could desire.

'The leaves which had been gathered in fine weather, towards the close of the preceding autumn, and before any injury from frost could have been experienced, were first spread on cloths and dried in the sun, and then reduced to powder; this was preserved through the winter in a perfectly dry place. Before giving it as food to his newly-hatched brood, the powder was slightly moistened with water, and a thin layer of it being placed around the insects, they immediately and with avidity began to feed, preferring it to every

substitute which was offered, and thriving upon it satisfactorily.

'While the hope still remained of naturalizing the silkworm in England, the means of procuring a sufficient supply of appropriate food, was considered as one of the greatest obstacles to its success; and the attention of such persons as interested themselves in the pursuit was consequently engaged, in ascertaining by experiment whether other leaves than those furnished by the mulberry tree, might not be favorably substituted.

'Among others, the Rev. Mr. Swayne exhibited much anxiety for the success of this object, with the praiseworthy desire of providing profitable employment for such of the poorer classes as might be too feeble for manual labor; most of the duties required in attendance upon the silkworm being such as can easily be fulfilled by women, children, and aged persons.

'This gentleman made various trials as to the relative merits of different kinds of nourishment. For this purpose, he placed equal numbers of newly-hatched worms in three different boxes, which he numbered 1, 2, and 3. The contents of number 1. he fed entirely with leaves of the white mulberry; the insects in number 2. were nourished with those of the black mulberry; and the worms in number 3. were furnished with lettuce leaves until their first age was passed, and thereafter with the black mulberry leaf. These last worms were of a paler color, and grew more rapidly than the others. The result, however, seems to prove that, although lettuce leaves may yield bodily nourishment to the insect, they contribute little towards the secretion of that peculiar matter which constitutes its value. When the spinning had been completed, twelve of the finest cocoons were chosen from each of the three divisions, and were found to be of the following weights:—

Cocoons of	No. 1.	weighed	7	dwts.	2 grains.
Ditto -	No. 2.	-	6	-	3
Ditto -	No. 3.	-	6	-	0

None of these results were very encouraging to the cultivator, but the experiment clearly evinced the superiority of the white mulberry over the other kinds of nourishment.

'Many communications upon this subject are to be found in the volumes recording the Transactions of the Society for the Encouragement of Arts, &c. A letter from Miss Rhodes relates, that in the summer of 1785, she subsisted several thousand worms entirely on lettuce leaves during three weeks, and that for the remaining short term of their lives, she afforded them their natural food. At the end of a month from their first hatching, they began to spin, and eleven ounces of silk were procured from four thousand cocoons. After repeated trials, this lady had become convinced that

silkworms could not safely be fed on lettuce leaves for a longer period than three weeks; as on persisting further in their use, the greater part of the worms died without forming their cocoons. Some, indeed, possessed sufficient vigor to spin and to produce perfect and well-formed balls, even when lettuce leaves had constituted their only food. Reasoning from this fact, Miss Rhodes was brought to suspect that the premature mortality of her brood was not altogether occasioned by the unwholesome nature of the aliment on which they had fed, but might be owing to some extraneous circumstance; and further observation led her to the conclusion that it was the coldness of the lettuce leaves rather than any inherent property which made them detrimental. This lady having thence suggested that if the worms were kept in a higher temperature, they might be successfully supported through their lives on lettuce leaves; general Mordaunt caused a considerable number to be hatched and reared in his hot house. These were fed entirely on lettuce leaves; they throve and went through all their mutations as satisfactorily as if fed with their natural nourishment; scarcely any among them died, and the number and quality of the cocoons that were gathered proved the entire success of the experiment. If a solitary trial be sufficient to establish a fact, this must certainly be satisfactory to those who consider it desirable to naturalize silkworms in England, where, owing to the inequality of seasons, the appearance of mulberry leaves must always be uncertain in regard to time. Lettuce leaves have an advantage over other vegetables which have been offered as substitutes for the mulberry, that they may be gathered in wet weather without themselves being wetted, as a lettuce, once cabbaged, resists the entrance of all moisture within; and the heart being always perfectly dry, ensures nourishment to the worm, free from that moisture which is always found to affect it injuriously.

'Mrs. Williams, an earlier correspondent of the society whose "Transactions" have been quoted, gives a very minute and copious account of the various trials which she made of vegetable substances as substitutes for mulberry leaves. Having hatched her brood in severely cold weather, when even lettuces were not easily procurable, she offered to her worms the tender parts of blackberry leaves, and relates that the worms ate them greedily. She next presented to them young leaves of the elm, and reports that equal success attended this trial: encouraged by these facts, she then succeeded in causing the insects to feed on the leaves and flowers of the sweet cowslip and primrose. But meanwhile the mulberry had put forth its leaves, and having procured some of these for her brood, it was thenceforth vain to offer them any oth-

er kinds of food: all were rejected; and another proof was afforded, that the mulberry tree, which no other insect will attack, is alone adapted to the natural desires of the silkworm. Mrs. Williams records one peculiarity which discovered itself throughout her investigation; by no means could the worms be brought to touch any flower of roseate hue. Pinks, roses, sweet williams, polyanthoses, were each in turn offered by this persevering lady, and were all rejected without hesitation. It is proper to remark, that these experiments of Mrs. Williams are not confirmed by those of any other person, but, on the contrary, that Miss Rhodes was unsuccessful in every endeavor to repeat them, and succeeded only in reconciling her silkworms to the use of lettuce and spinach.

'Attempts to discover a substitute for the mulberry are not entirely abandoned even at the present time. It is recorded in the Bulletin Universel, for 1829, that Madamoiselle Coge of Epinal, has used with success the leaves of the scorzonera (viper grass) for the nourishment of silkworms. The silk produced by worms fed on this leaf, is represented to be in no respect inferior to that from worms kept on the natural food.

'Notwithstanding, however, this last announcement, and the partial success so frequently recorded as attending the substitution of the lettuce, all practical cultivators of silk continue to be convinced that it would be unprofitable to feed their worms on any save their natural nourishment; and the most intelligent writers on the subject, approve the practice of destroying, as useless, any worms, which through ill management may be hatched before the mulberry tree has put forth leaves sufficient for their support.

'Recent attempts which have been made to rear silkworms in England, do not offer much encouragement to the pursuit, except as matter of amusement. Some pairs of silk stockings of good quality are to be seen in the gallery of "The National Repository," woven from silk of home production. The worms which spun this were reared by Mrs. Allen of Wandsworth, the result of whose careful observations on this subject has been obtained.

'The difficulty of procuring a sufficient and continuous supply of proper food was the reason why this lady was obliged to relinquish a pursuit in which she had taken much pleasure for four successive years.

'Mrs. Allen's testimony strongly corroborates the necessity of extreme cleanliness in preserving the health of the worms. The most scrupulous attention seems to have been paid by her to this particular, as well as to the dryness of the leaves, and the temperature of the apartment wherein the insects were reared and set to spin; and yet a very great mortality was always experienced

among them, scarcely more than one in five of the worms that were hatched coming to maturity and forming their cocoons. Of these it required one thousand to furnish an ounce of reeled silk, the floss being equal to a quarter of an ounce more. The cocoons were gathered in eight days from their commencement, and in eight days more were wound off. No necessity hence arose for destroying the vitality of the insects to prevent their piercing the balls. The chrysalides being placed in bran, in due time became moths and produced eggs, each female furnishing between three and four hundred.'

THE WHITE PINE.

Pinus strobus.

Fig. 1. A leaf. Fig. 2. A cone. Fig. 3. A seed.

This species, one of the most interesting of the American pines, is known in Canada and the United States by the name of *White Pine*, from the perfect whiteness of its wood when freshly exposed; and in New Hampshire and Maine by the secondary denominations of *Pumpkin Pine*, *Apple Pine*, and *Sapling Pine*, which are derived from certain accidental peculiarities. This tree is diffused, though not uniformly, over a vast extent of country; it is incapable of supporting intense cold, and still less extreme heat. It is first observed in the north about forty leagues from the mouth of the river Mistassin, which discharges itself into Lake St. John in Canada, in the latitude of 48° 50′. It appears to be most abundant between the 43d and 47th degrees of latitude; farther south it is found in the valleys and on the declivities of the Alleghanies to their termination, but at a distance from the mountains on either side, its growth is forbidden by the warmth of the climate. It is said with great probability to be multiplied near the

source of the Mississippi, which is in the same latitude with the state of Maine, the upper part of New Hampshire, Vermont, and the commencement of the St. Lawrence, where it attains its greatest dimensions. In these countries it is seen in very different situations, and it seems to accommodate itself to all varieties of soil except such as consist wholly of sand, and such as are almost wholly submerged. The largest stocks are found in the bottom of soft, pliable and fertile valleys, on the banks of rivers composed of deep, cool, black sand, and in swamps covered with a thick and constantly humid carpet of *sphagnum*.

Near Norridgewock on the river Kennebeck, in one of the swamps, which is accessible only in midsummer, M. Michaux measured two trunks felled for canoes, of which one was one hundred and fifty-four feet long and fifty-four inches in diameter, and the other one hundred and forty-two feet long, and forty-four inches in diameter, at three feet from the ground. Mention is made in Belknap's History of New Hampshire, of a white pine felled near the river Merrimack, seven feet eight inches in diameter. M. Michaux likewise measured a stump near Hallowell, Maine, exceeding six feet in diameter: these enormous trees had probably reached the greatest height attained by the species, which is about one hundred and eighty feet. But this ancient and majestic inhabitant of the North American forests, is still the loftiest and most valuable of their productions, and its summit is seen at an immense distance aspiring towards heaven, far above the heads of the surrounding trees. The trunk is simple for two-thirds or three fourths of its height, and the limbs are short and verticillate, or disposed in stages one above another to the top of the trees, which is formed of three or four upright branches seemingly detached and unsupported. In forests composed of other trees, where the soil is strong and proper for the culture of corn, as for example on the shores of Lake Champlain, it is arrested at a lower height and diffused into a spacious summit; but it is still taller and more vigorous than the neighboring trees. On young stocks, not exceeding forty feet in height, the bark of the trunk and branches is smooth and even polished; as the tree advances in age it splits and becomes rugged and gray, but does not fall off in scales like that of the other pines. The white pine is also distinguished by the sensible diminution of its trunk from the base to the summit, in consequence of which, it is more difficult to procure sticks of great length and uniform diameter: this disadvantage, however, is compensated by its bulk and by the small proportion of alburnum. The leaves are five-fold, four inches long, numerous, slender, and of a bluish green: to the lightness and delicacy of the foliage is

owing the elegant appearance of the young trees. The male aments are four or five lines long, united to the number of five or six, and arranged like those of the loblolly and long-leaved pines: they bloom in the month of May, and turn reddish before they are cast: the cones are four or five inches long, ten lines in diameter in the middle, pedunculated, pendulous, somewhat arched, and composed of thin, smooth scales, rounded at the base. They open about the first of October, to release their seeds, of which a part are left adhering to the turpentine that exudes from the scales.

The wood of this species is employed in greater quantities and far more diversified uses than any other American pine; yet it is not without essential defects; it has little strength, gives a feeble hold to nails and sometimes swells by the humidity of the atmosphere. These properties are compensated however by others which give it a decided superiority; it is soft, light, free of knots, and easily wrought, is more durable, and less liable to split when exposed to the sun, furnishes boards of a great width, and timber of large dimensions, in fine, it is still abundant and cheap. It is observed that the influence of soil is greater upon resinous than upon leafy trees. The qualities of the white pine, in particular, are strikingly affected by it. In loose, deep, humid soils, it unites in the highest degree all the valuable properties by which it is characterized, especially lightness and firmness of texture, so that it may be smoothly cut in every direction; hence the name ***Pumpkin Pine.*** On dry, elevated lands, its wood is firmer and more resinous, with a coarser grain and more distant concentric circles, and it is then called ***Sapling Pine.*** The wood of this tree is used for every species of ornamental work about building, for ***clap boards***, and shingles, for looking glass and picture frames, for images in sculpture, the inside of mahogany furniture and of trunks, in cooperage and an endless variety of other purposes. It serves exclusively for the masts of the numerous vessels constructed in the Northern and Middle States. The principal superiority of these masts over those exported to England from Riga is their lightness; but they have less strength, and are said to decay more rapidly between decks and at the point of intersection of the yards: this renders the long-leaved pine superior to the white pine in the opinion of the greater part of American ship builders. The bowsprits and yards are also made of white pine. The wood is not resinous enough to furnish turpentine for commerce, nor would the labor of extracting it be easy, since this tree occupies exclusively, tracts of only a few hundred acres, and is usually mingled in different proportions with the leafy tree. *Sylva Americana.*

METEOROLOGICAL JOURNAL,

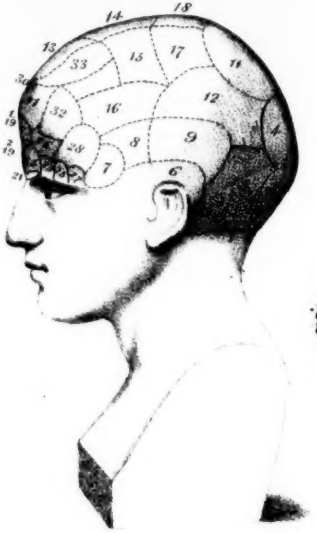
KEPT AT BOSTON, FOR JUNE, 1832.

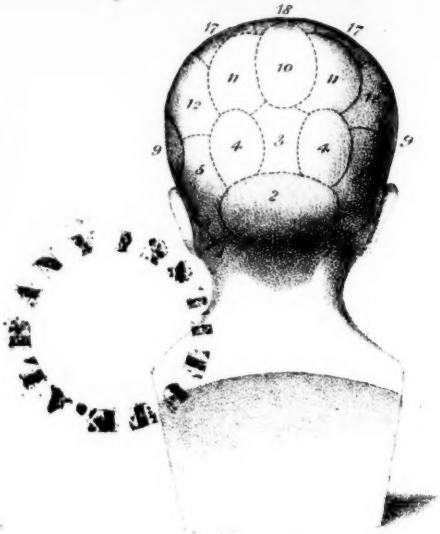
[From the Daily Advertiser.]

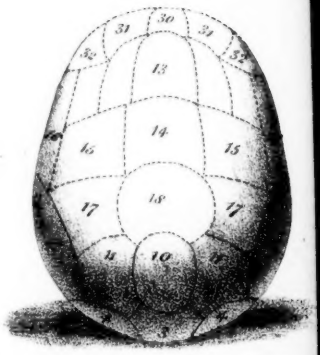
Day.	THERMOMETER.			BAROMETER.			FACES OF THE SKY.			DIRECTION OF WINDS.			RAIN.
	Morn.	Noon.	Even.	Morn.	Noon.	Even.	Morn.	Noon.	Even.	Morn.	Noon.	Even.	Inches.
1	70	91	80	30.08	30.08	30.05	Fair	Fair	Fair	S. W.	N. W.	N. W.	
2	72	82	67	30.05	30.07	30.07	Fair	Fair	Fair	N. W.	E.	N. E.	.42
3	63	70	63	30.07	30.00	29.95	Cloudy	Fair	Fair	E.	E.	S. W.	1.14
4	66	81	70	29.94	29.94	29.97	Fair	Fair	Fair	S. W.	S. W.	S. W.	.35
5	63	82	72	29.97	29.98	29.99	Cloudy	Fair	Fair	S. W.	S. W.	S. W.	
6	68	78	68	30.00	30.09	30.09	Cloudy	Cloudy	Fair	S. E.	S. W.	E.	.16
7	62	68	60	30.10	30.12	30.10	Cloudy	Cloudy	Fair	N. E.	N. E.	E.	
8	58	69	68	30.10	30.10	30.10	Fair	Fair	Fair	E.	E.	S. W.	.58
9	58	80	66	30.11	30.11	30.14	Fair	Fair	Fair	N. W.	S. W.	S. W.	
10	63	85	74	30.14	30.15	30.12	Fair	Fair	Fair	S. W.	S. W.	S. W.	
11	70	75	71	30.12	30.12	30.07	Fair	Fair	Fair	S. W.	S.	S. W.	
12	69	89	74	30.04	30.02	30.01	Fair	Fair	Fair	S. W.	S. W.	S. W.	
13	70	88	73	30.00	30.03	30.04	Fair	Fair	Fair	S. W.	S. W.	S. W.	
14	70	76	67	30.04	30.06	30.05	Cloudy	Cloudy	Rain	S. W.	S. W.	S. W.	.73
15	67	64	60	30.07	30.12	30.10	Cloudy	Cloudy	Rain	N.	N. E.	N. E.	
16	59	64	60	30.12	30.15	30.15	Cloudy	Cloudy	Rain	N. E.	N. E.	N. E.	
17	60	73	66	30.05	30.04	29.98	Rain	Fair	Fair	N. E.	N. W.	S. E.	
18	67	82	76	29.99	30.00	30.00	Fair	Fair	Fair	S. W.	E.	S. W.	
19	73	82	71	30.00	30.00	30.00	Fair	Cloudy	Fair	S. W.	S. W.	N. W.	
20	70	84	76	30.00	30.00	30.00	Fair	Fair	Fair	N. W.	S. W.	S. W.	
21	74	76	73	29.95	29.87	29.83	Cloudy	Fair	Fair	S. W.	E.	N. W.	
22	66	76	68	29.94	29.99	30.04	Fair	Fair	Fair	S. W.	N. E.	N. E.	
23	60	55	53	30.10	30.10	30.15	Rain	Rain	Fair	N. W.	N. E.	N. E.	
24	43	49	56	30.24	30.23	30.23	Fair	Fair	Fair	N. W.	E.	S. E.	
25	52	66	59	30.28	30.20	30.18	Fair	Fair	Fair	N. W.	E.	S. W.	
26	53	66	62	30.15	30.22	30.30	Fair	Fair	Fair	N. W.	E.	S. W.	
27	61	72	66	30.31	30.30	30.20	Fair	Cloudy	Rain	S. W.	S. W.	S. W.	
28	66	78	72	30.08	30.00	29.38	Fair	Cloudy	Fair	S. W.	S. W.	S. W.	
29	69	74	70	29.94	29.92	29.93	Cloudy	Cloudy	Fair	N. W.	E.	N. E.	.30
30	66	72	65	30.04	30.12	30.20	Fair	Fair	Rain	N. W.	E.	N. E.	

Depth of rain fallen 3.53 inches.

Hours of observation, at sunrise, 1 o'clock, and 10 P. M.







Pendleton's Lithog.ʸ Boston

NAMES OF

PHRENOLOGICAL ORGANS

referring to the figures indicating their

RELATIVE POSITION.

I. Propensities.

1 *Amativeness*
2 *Philoprogenitiveness*
3 *Concentrativeness*
4 *Adhesiveness*
5 *Combativeness*
6 *Destructiveness*
7 *Constructiveness*
8 *Acquisitiveness*
9 *Secretiveness.*

II. Sentiments.

10 *Self esteem*
11 *Love of approbation*
12 *Cautiousness*
13 *Benevolence*
14 *Veneration*
15 *Hope*
16 *Ideality — Wonder*
17 *Conscientiousness*
18 *Firmness.*

III. Intellect.

19 *Individuality* } *or higher*
} *or lower*
20 *Form*
21 *Size*
22 *Weight*
23 *Colouring*
24 *Locality*
25 *Order*
26 *Time*
27 *Number*
28 *Tune*
29 *Language*
30 *Comparison*
31 *Causality*
32 *Wit*